"A Methodology for the Analysis of Special Hazard Halon 1301 Systems and Replacement Alternatives-"

Using Fire Protection Systems and Hazards Analysis (FPSHA)

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1.0 Introduction

Increasing environmental concern over the effect that Halons have on the ozone layer has created a problem of major concern for the not only the users of Chlorofluorocarbons (CFCs) but also the **users** of Halon 1301 for special hazard protection. Now that there will be an earlier phaseout of the CFCs, there is increasing pressure on the use of Halon tire protection agents. While the replacement of Halon 1301 is a problem for all users, it is generally easy to replace systems protecting computer rooms, and most other smaller systems. However, where Halon 1301 is used to protect special hazards, there are a number of problems and considerations that greatly complicate the situation. **An** example of the problem facing a user with a special hazard installation is that there are no direct and suitable replacement agents presently available or forecast for the near future. If this is the case, then a special action and review plan known as a Fire Protection Systems and Hazards Analysis (FPSHA) *can* be used by these users if they elect to review the alternatives and options with respect to their Halon 1301 systems. To provide a basis for the action and review plan, the following area will be discussed: What **is** FPSHA?; When is it **needed?;** Special definitions; What makes up an FPSHA; Special considerations; and alternatives and options.

2.0 What Is **Fire** Protection Systems and Hazards Analysis ?

Fire Protection Systems and Hazards Analysis is an integrated and systematic approach to collect, review, analyze and document the results and conclusions of a fire protection review study. FPSHA embodies the full **scope** of the systems approach, reviewing all aspects of the situation, including those normally thought to be outside the normal realm of fire protection such as: ergonomics, environmental protection, personnel safety, security, public relations, operations and maintenance, master planning, etc. The FPSHA ***starts*** with the present system, analyzing the system history, capabilities, and installation, then proceeds to

evaluating the characteristics of the overall facility/room/area system, a review and evaluation of the process hazards and risks, the fire protection options, the process options, a comparison of the alternatives and options, and the documentation of the results and outputs of the analysis.

3.0 When Is FPSHA Needed?

Typically, a detailed **FPSHA** only need to be done for Halon 1301 systems that protect "special hazards" such as high risk situations; extremely sensitive political, regulatory, life safety, high dollar or public relations situations; "No Win" situations; Unknown systems/problems; or to develop and document a specific set of guidelines. Due to the type of detail and cost, it is not always cost effective to conduct a full FPSHA, and in these cases, a simplified **FPSHA** *can* be conducted. In general, for the purposes of FPSHA, a special hazard is any hazard that: is not specifically covered under normal fire codes; normal fire protection systems cannot provide the required level of protection; or the hazard is such that in addition to fire protection other types of protection must be provided. To simplify the overall concept, and *to* provide a wider base for the review, under FPSHA, a process is any process, operations, or activity that occurs in the area to be protected. Under this broad terminology, it *can* be established that a process *can* range from the computer collection and analysis of data, to an oil production facility, or a special test facility.

4.0 Examples Where A Detailed FPSHA Might Be Needed

Examples of where a detailed **FPSHA** would normally be required include: cold region oil production facilities; off shore oil production facilities; special test facilities; special computer rooms; museums; and nuclear power plants. Each of these has a special set of problems and considerations that makes normal fire protection concepts and systems unworkable.

5.0 Establishing the Basic Action Path

In establishing the basic action path for determining the possible alternatives, specific data and information must be gathered from which to build the basis for the study. This information would include; historical information on the system, facility, hazards and

installation; determining and documenting the methodologies used to chose the original protection systems; an evaluation of present and future hazards, facility short and long range planning options, and needs; an evaluation and comparison of the various fire protection system capabilities, needs and requirements against the total system needs.

6.0 The Five Major Components **Of** Fire Protection System And Hazard Analysis

As with every methodology, there are a series of steps that must be undertaken to accomplish the task. With FPSHA, there are five *(5)* major analytical steps: Fire Protection Design Analysis; Facility Design Analysis; Value Engineering and Management; Cost/Benefit Analysis; and **FLALAR** Analysis. Each of these steps contributes a special portion of the total analysis, and are inter-dependent parts of the FPSHA.

6.1 Fire Protection Design Analysis

Fire Protection Design Analysis, is a quantitative analytical review of the fire protection needs, requirements, and situations to establish the level, type, and extent of hazards that may be present or expected. FPDA uses the techniques of Design Model Fires, Model Fire Scenarios, computer and intuitive fire modelling, life safety and Injury analysis, etc.

6.2 Facility **Design** Analysis

Facility Design Analysis is an analysis of the facility based on short and long range plans and utilization planning. This includes the overall condition, modifications, upgrades, and future uses of the facility. Included as part of this analysis is the suitability of a facility to meet present, planned and future uses with and without modifications and upgrade.

6.3 Value Engineering and Management

An often overlooked but very important consideration in the near future will be Value Engineering and Management (VEM). **VEM** will become increasingly important as project cost continue to increase. and the fund available for these projects continues to decrease. A VEM study is important, since it looks beyond the planned scope of the project, looking for alternatives hat still reliably accomplish the required functions and also meet the quality and availability expectations.

6.4 Cost/Benefit Analysis

A Cost/Benefit Analysis is a comparative analysis of various options and alternatives on a quantitative basis usually using a direct cost comparison. These comparisons *can* be done using comparative charts, graphs, or numerical comparisons. Typically, the comparison uses two or more options and their respective costs against a fixed comparison.

6.5 FLALAR

FLALAR (Fire Losses As Low As Reasonable) is a methodology using a combined analytical methods to determine the optimum level of fire protection for a given set of conditions and hazards. This analysis is also used to establish the specific parameter under which the fire protection system must operate. The specific goals that might be met include; protection of the public and employees; protection of the environment; and protection of national security. These goals must be arrived at based on a cost/benefit and hazard and risk acceptance basis.

7.0 Special Areas of Concern To FPSHA

Since FPSHA approaches the problem as a system, there are a number of other areas that may have to be considered in the overall systems approach to determine the fire protection scheme. Four typical special areas of concern include security, personnel safety, environmental protection, and public relations. Not normally considered in a fire protection system review, each of these areas, and others *can* be of major concern where a special hazard in concerned. For example, security problems *can* include not only the protection of sensitive data from normal threats, but from terrorist attacks, or even to provide a system that insures that only a limited number of emergency personnel will require access in the event of a fire. Considering personnel safety, this could include protection of personnel from a toxic or hazardous fire suppression agent, fire products, or even insuring that safe egress will be available under all conditions. In the area *of* environmental protection, this would include not only the fact that the agent must be considered and its pollution potential, but the ability of the fire protection systems and process systems to prevent a major pollution incident. And for the public relations area, there of course is the bad publicity that a fire causes, but also the potential long range negative impact of public concern that may create

new regulations and controls. These are only examples of the problems and problem areas that may arise.

7.1 Special Safety Considerations

As mentioned earlier, a very special concern of **FPSHA** is the safety of the employees and any other persons who may be in the area. Some of the special safety concerns include the ability to safely exit the fire area, taking into consideration not only the fire and smoke, but also the effects of the agent. The protection of employees from the actual fire is also a major concern in that will the fire protection system prevent or at least minimize the injury to employees from burns and smoke inhalation among other problems. Some agents may also require that the effects of the fire suppression agent in the adjacent areas be considered, since **HVAC** systems, etc. may *carry* the agent to other areas. As a result of these considerations, the agent selection, process system design, etc. may be impacted.

7.2 Special Suppression Considerations

In the **FPSHA,** special attention is paid to a number of criteria that a fire suppression agent and system must meet. Some of these criteria include: agent toxicity and safety; agent effectiveness; agent disposal, system design demands, detection system demands; facility.area upgrades and requirements; agent damage; process impacts; nuclear safety ; and the possibility of using multiple agents.

7.3 Special Detection Considerations

As with the suppression agent and system, the detection system must also be carefully evaluated. Some of these considerations may include the following: no one detector type can provide complete protection all of the time; facility changes may require detector changes; detector selection must be based on an evaluation of the area to be protected, not only on the code(s); detector response should be matched to hazard requirements; special hazards may require multiple detector types and special placement of detectors; and detector selection may be especially critical to any special system. What is not considered in many instances and *can* be a major factor is the environment of the protected area including such problems as dust, the relative humidity level, salt spray, radiation level, temperature, static electricity,

nuisance smoke, etc. for normal operating, emergency and shutdown conditions. All of the factors listed can greatly affect the operability, reliability, and maintenance requirements of the detection system.

8.0 Special Points

In the evaluation, and reviews, there are a number of special points that must be considered. One of the key points is that any fire no matter how small in a special hazard will cause damage of some sort, And that it is usually easier or more practical to repair water damage than fire damage. A subset to this type of corollary is that no matter how quickly a fire is detected, it has still a fire, and has usually already caused some damage. In a similar vein, fire suppression does not always mean fire extinction. We must note that all a fire suppression system can accomplish in some cases is to contain the fire. Keeping *these* two special considerations in mind may prevent other problems. These considerations are that the best system *can* be rendered ineffective by a change in the facility, mission, etc. People *can* do more damage to a system than a fire, by inaction, over-reaction, etc. For special hazards, we must also consider the fact that the codes cannot cover every eventuality, and that we may have to engineer the solution to a problem. All these areas and more must be considered in the evaluation phase.

9.0 What Can Be Done for Special Hazards?

During the FPSHA, various options must be evaluated. These options include; doing nothing; removing the halon system; removing the halon system and installing a new suppression system; removing the halon system and installing new suppression and detection systems; keeping the halon and installing a new detection system; upgrading the processes; fire prevention techniques; and providing redundant processes. This is not a comprehensive list of all of the options, but a listing of the more common options each of which has its own advantages and disadvantages. As noted earlier, these should be evaluated, the evaluation documented, and the evaluation process and methods noted for future reference. In general, if an option is considered, it should be documented, in the event of future questions and problems. Within each of the options noted above, there is a set of specific areas of study,

the suppression system, the detection system, and the process, each of which will first have to be studied, then that study integrated into the overall systems study before reaching the final conclusions.

10.0 Common Suppression System Alternatives

The selection of an alternative fire suppression system should include the most common systems such as wet, dry and preaction sprinkler systems, alternate halons, and carbon dioxide. However, in special cases, the more common system will not provide the required, or desired level of protection, therefore other systems such as dry chemical, foam (low, medium and high expansion) sprinkler and deluge systems, alternate Halons, and inert gases must also be investigated. The general criteria here are the suitability of the agent and system to provide the required fire suppression capability, match facility requirements limitations, provide the required level of personnel safety, and the required level of hazard control. Unconventional hazards and problems may require unconventional solutions. Additionally, the fire suppression system must be matched to the tire detection system.

11.0 Common Fie Detection Options

The more common fire detection options include the various standard systems such as ionization detectors, spot and beam photoelectric detectors, combined ion/photoelectric detectors, linear and spot thermal detection, and ultraviolet andlor infrared optical detection. For special hazard problems, several other less common fire or problem detection systems may be needed, these include equipment fault detection, gas detection, and integrated fire/process detection systems. The major selection factors here include the reliability, detection capability, detection response time, maintenance requirements, and fire suppression system requirements. The detection system must be matched to the hazard and the other fire protection system.

12.0 Options in Addition to Standard Fie Protection System Options

In addition to the standard fire protection system options, since FPSHA considers the problem using the system approach, other options should also be considered, such as:

redundant process systems; special backup systems; special fire prevention techniques; isolation of the hazard; multiple fire protection systems; process system redesign; alternate process system controls and equipment; new equipment, processes or chemical; and accepting the risk and provide damage control. Any one or more may need to be considered and implemented, since in FPSHA, the goal is not only to determine the best fire protection, but the best overall system protection.

13.0 Documenting an FPSHA

The FPSHA research, evaluations, and conclusions must be carefully recorded and documented. This includes such items and information as: the evaluation criteria; alternatives investigated; historical information; quantitative analyses; short and long range facility plans; regulatory analyses; economic analyses; drawings and sketches; and all calculations. All information used for the FPSHA should be packaged into a stand alone document and archived. Additionally, this should not be considered a "one-time" evaluation, but a living evaluation that may have to be updated, revised, and even modified over the life of the facility.

14.0 Summary

In the evaluation of the alternatives for a special hazard, it may be necessary to evaluate and review the various options, consequences, situations and problems in detail. FPSHA *is* a possible methodology of exploring these areas these areas based on the level of detail and level of sensitivity needed for the project. With the many code, regulation and litigation problems present, careful attention must be paid to detail and documented before any system decisions can be made and action paths chosen.

15.0 References

"The Halon Phaseout Speeds Up," Jeff L. Huntington, Fire Journal ,March/April 1993.

Due to the limited *space,* the remaining references *can* be found in the following papers also prepared by the author: "Building Fire Hazard Analysis (BFHA) - Providing Fire Protection For Special Hazard and Problems," and "A Methodology for the Analysis of Special Hazard Halon 1301 Systems and Replacement Alternatives - Preliminary Report."